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Numerical study of plasma generation process and internal antenna heat loadings in J-PARC RF negative ion source

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Plasma generation process and thermal heat loadings from plasma to internal antenna in J-PARC RF ion source are investigated by EM-PIC MC (Electro -Magnetic Particle-In-Cell Monte-Carlo) code coupled with SOR (Successive -Over-Relaxation). From the experimental study, it has been clarified that the life-time has strong relation with defects or inclusions produced in manufacture process [1].

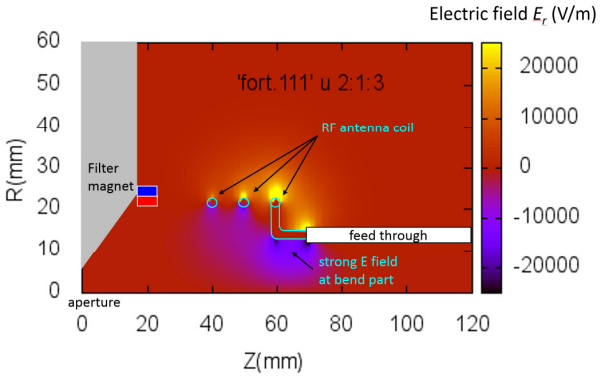

Fig.1 SOR calculation result of capacitive electric field due to potential given on RF antenna; 240V on the first turn (Z=60mm) of antenna coil and bend part, 160 and 80V on the second and third turn of coil (Z=50, 40mm), respectively.

On the other hand, thermal heat loadings from plasma to antenna surface is another candidate for cause of the failure. Optimization of the plasma (e-, H^+, H_2^+ and Cs^+) acceleration to antenna surface may lead to relax the criteria of antenna manufacture for preventing the failure of RF antenna. The numerical model solves (i) plasma transport with collisions, (ii) induced EM field and (iii) capacitive electric field by antenna surface potential as shown in Fig.1, which shows strong capacitive electric field produced at the bend part and near feed through. Spatial distributions of heat loadings onto the antenna for different plasma particle species are calculated and reported in the paper.

Reference

[1] R. F. Welton, V. G. Dudnikov, B.X. Han, et al., AIP Conf. Proc. **1515**, 341 (2013).